

# **ReactJS.**

## The basics

# ReactJS.

- **A Javascript Single Page App (SPA) framework for building dynamic Web User Interfaces.**



- **Client-side framework.**
  - **More a library than a framework.**

# Before ReactJS.

- **Traditional SPAs promoted the MVC pattern for app design.**
  - **Ex: AngularJS, EmberJS, BackboneJS etc.**
- **React is not MVC, just V (and maybe some C).**
  - **It challenged established best practice (MVC).**
- **MVC frameworks use template technology at the V layer; React based on components**

	<b>Templates</b>	<b>React components</b>
Separation of concerns	Technology (JS, HTML)	Responsibility “Display UI”
Semantic	New concepts and micro-languages	HTML and Javascript
Expressiveness	Underpowered	Full power of Javascript

# ReactJS

- **Philosophy:** *Build components, not templates*
- **All about the UI (User Interface).**
  - Not about business logic or the data model.
- **Component: A unit comprised of HTML(ish), JS, and data.**
  - UI description (HTML) and UI behavior (JS) are tightly coupled and co-located.
    - Other SPA frameworks decoupled these aspects.
- **Benefits:**
  1. Composability.
  2. Reusability.
  3. Performance.

# Creating the UI description

- `React.createElement()` – **create a DOM element.**
- `ReactDOM.render()` – **attach an element to the current DOM.**
- **Ref. 01-UIDescription.html**
- `createElement()` **arguments:**
  - **type (h1, div, span etc);**
  - **properties (style, event handler etc);**
  - **children.**
- `render()` **arguments:**
  - **element to be displayed;**
  - **DOM node on which to mount the element.**
- **Ref. 02-UIDescription.html**
- **We never use `createElement()` directly – far too cumbersome.**

# JSX.

- **JSX – JavaScript extension syntax**
- **Declarative syntax for coding UI descriptions.**
- **Retains the full power of Javascript.**
- **Allows tight coupling between UI logic and description.**
- **Must be transpiled (Babel) for browser execution compatibility.**
  - **Reference [03-JSX-error.html](#)**

# REPL (Read-Evaluate-Print-Loop) transpiler.

The screenshot shows the Babel REPL interface in a Chrome browser. The URL is <https://babeljs.io/repl/#?babili=false&browsers=&build=&builtIns=false&spec=false&loose=false&co...>. The interface includes a left sidebar with settings and presets, a central code editor, and a right sidebar showing the transpiled code.

**SETTINGS**

- ☒ Evaluate
- ☒ Line Wrap
- ☐ Minify
- ☒ Prettify
- ☐ File Size
- ☐ Time Travel

**Source Type**

Module

**PRESETS**

- ☒ es2015
- ☐ es2015-loose
- ☐ es2016
- ☐ es2017
- ☐ stage-0
- ☐ stage-1
- ☐ stage-2
- ☐ stage-3
- ☒ react

**Code Editor**

```
1 let rootElement =
2   <div className='myCSSstyle' >
3     <h1>Languages</h1>
4     <ul>
5       <li>Ruby</li>
6       <li>Javascript</li>
7     </ul>
8   </div> ;
9
10 ReactDOM.render(rootElement,
11   document.getElementById('mount-point') );
```

**Transpiled Code**

```
1 'use strict';
2
3 var rootElement = React.createElement(
4   'div',
5   { className: 'myCSSstyle' },
6   React.createElement(
7     'h1',
8     null,
9     'Languages'
10  ),
11  React.createElement(
12    'ul',
13    null,
14    React.createElement(
15      'li',
16      null,
17      'Ruby'
18    ),
19    React.createElement(
20      'li',
21      null,
22      'Javascript'
23    )
24  )
25 );
```

**Reference**  
04-JSX.html

**Error Message:** React is not defined

# JSX.

- **HTML-like markup.**
- **It's actually XML code.**
- **Must be transformed (transpiled) into ES5.**
  - **The Babel tool suite.**
- **Some minor HTML tag attributes differences, e.g. className (class), htmlFor (for).**
- **Allows declarative description of the UI inlined in JavaScript.**
- **Combines the ease-of-use of templates with the power of JS.**



# Transpiling JSX.

- **What?**
  - **The Babel platform**
- **How?**
  1. **Manually, via REPL or command line.**
    - **When experimenting only.**
  2. **By the web server (using special tooling, i.e.Webpack).**
    - **Suitable for app development mode.**
  3. **As part of the build process for an app.**
    - **When deploying app for production.**

# React Components.

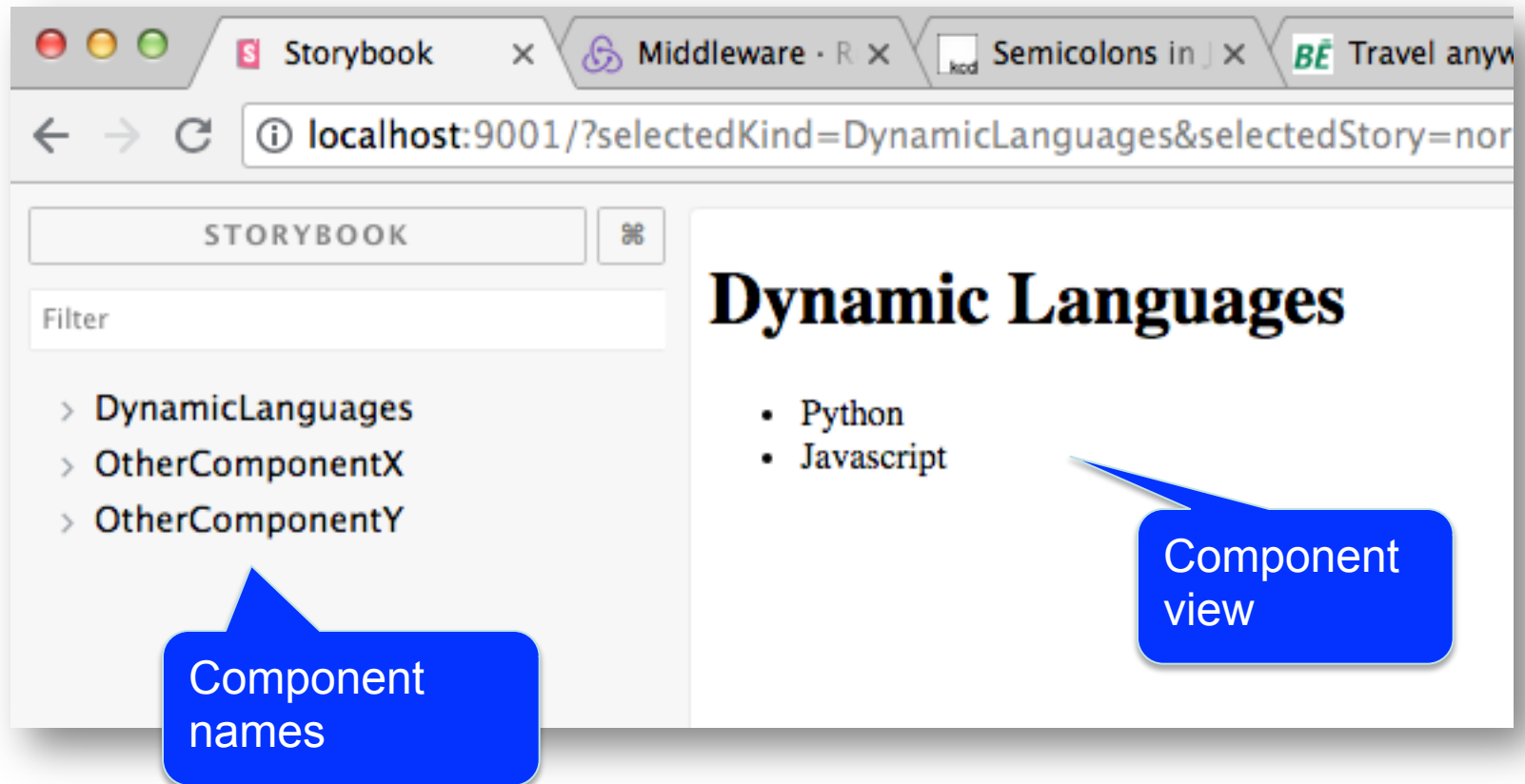
- **We develop COMPONENTS.**
  - **A class that extend** `React.Component`
  - The `render()` **method**:
    - **Mandatory.**
    - **Returns the component** UI description.
- **We reference components as HTML tags - `<ComponentName>`**
  - **E.g.** `ReactDOM.render(<ComponentName/>, . . . . )`
- **Reference** `05-simpleComponent.html`

# React Development tools.

- **The create-react-app tool. Features:**
  - a) Scaffolding/Generator**
  - b) Development web server – auto transpilation on file change + live reloading.**
  - c) Builder: build production standard version of app, i.e. minification, bundling.**
- **The Storybook tool:**
  - A development environment for UI components**
  - Runs outside of your app - develop component in isolation.**
  - Leads to more reusable, testable components**
  - Quicker development – ignore application-specific dependencies.**



- **Tool interface.**



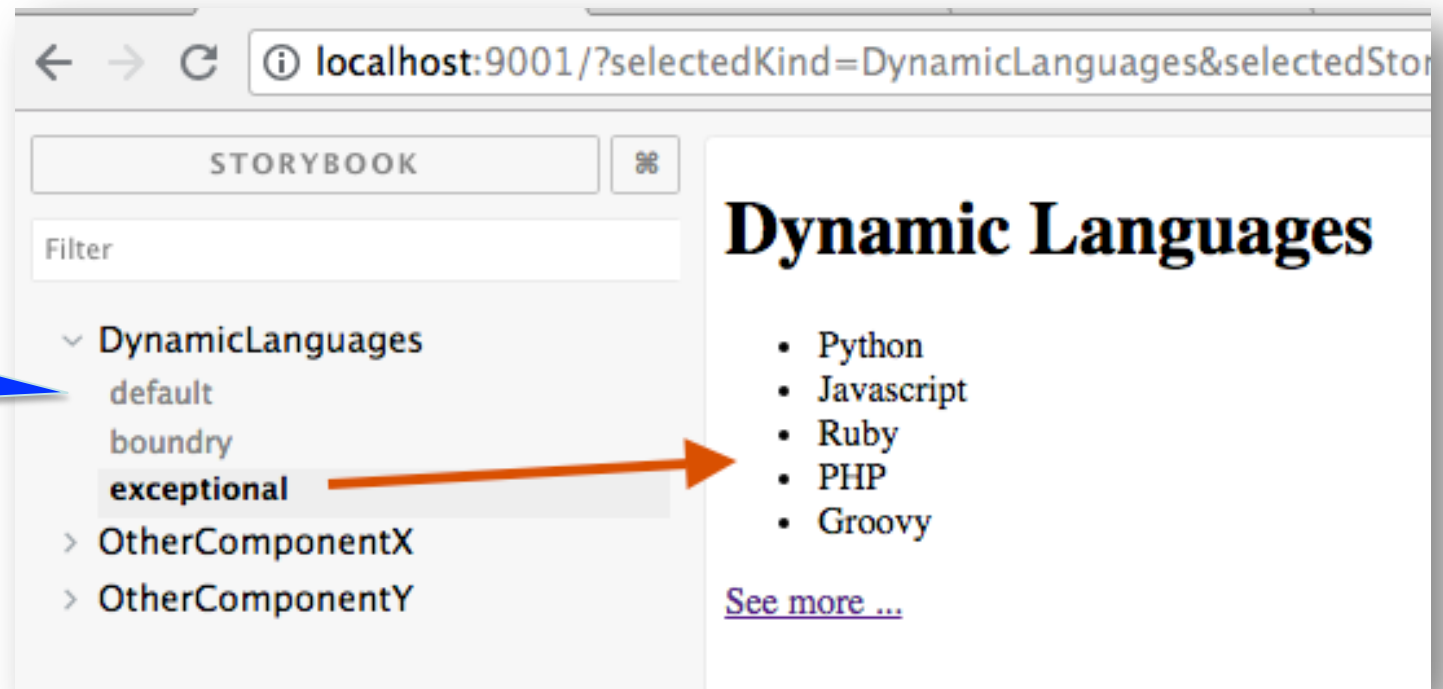
# STORYBOOK

- **Component design considerations:**
  - **A component may have several STATES → The state influences how it should render,**
- **EX.: DynamicLanguages component:**
  - **Default – list of languages less than 5 → Renders full list**
  - **Boundary – empty list → Render ‘No language’ message**
  - **Exceptional – More than 5 languages → Render first 5 and a ‘See More...’ link to display next 5.**
- **Each state case termed a STORY**

{ }

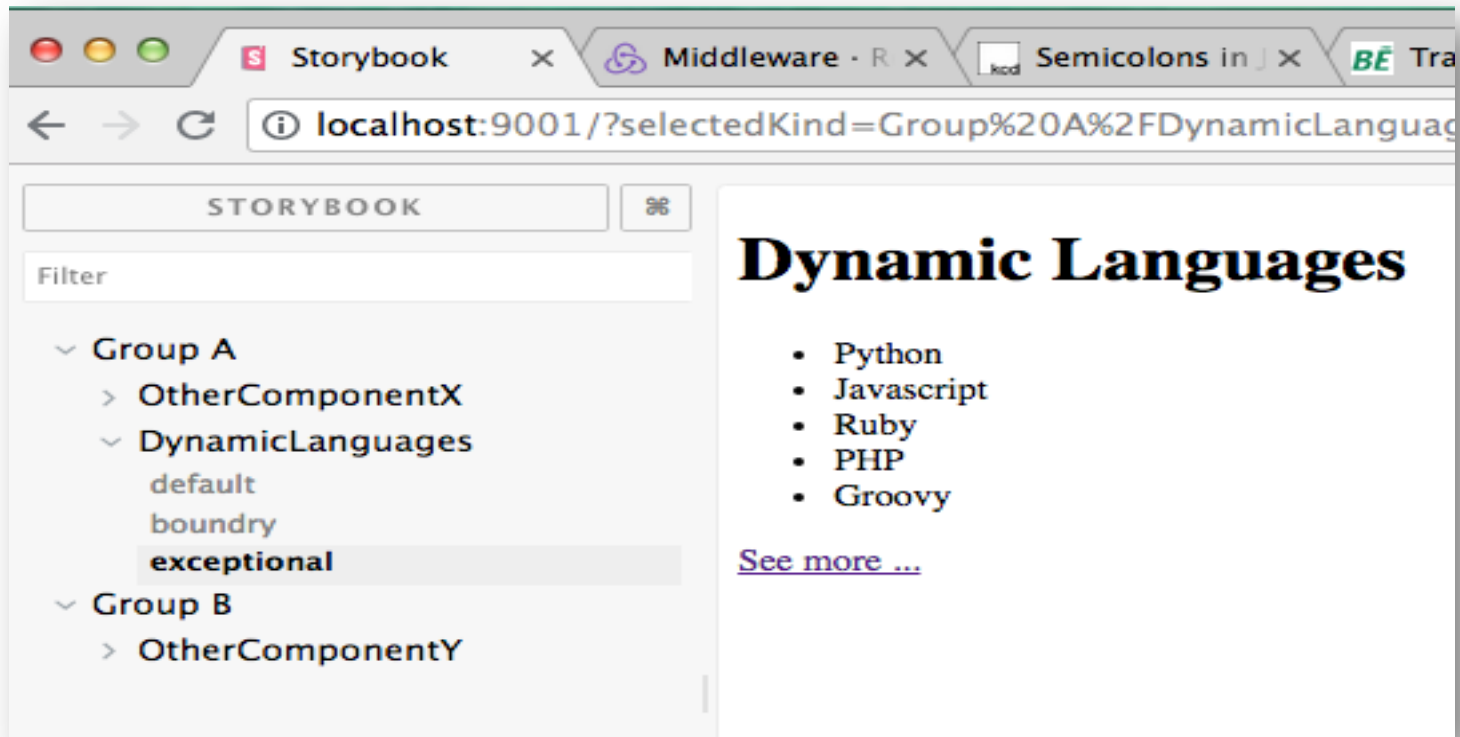
# STORYBOOK

- A component may have many stories.
- The tool allows us document them.





- For large component libraries, grouping helps others understanding the catalogue.



# Writing stories

- Tool provides a (fairly) declarative syntax for writing stories.
  - Like a domain specific language (DSL).

```
1 import React from 'react';
2 import { storiesOf } from '@storybook/react';
3 import DynamicLanguages from '../components/dynamicLanguages';
4
5 storiesOf('DynamicLanguages', module)
6   .add('default',
7     () => {
8       let languages = ['Python', 'Javascript', 'Ruby']
9       return <DynamicLanguages list={languages} />
10    }
11  )
12  .add('boundry',
13    () => . . . . .
14  )
15  .add('exceptional',
16    () => . . . . .
17  )
18
19 storiesOf('OtherComponentX', module)
20   .add('state 1',
21     () => . . . . .
22   )
23   . . . . .
```

Anonymous  
function

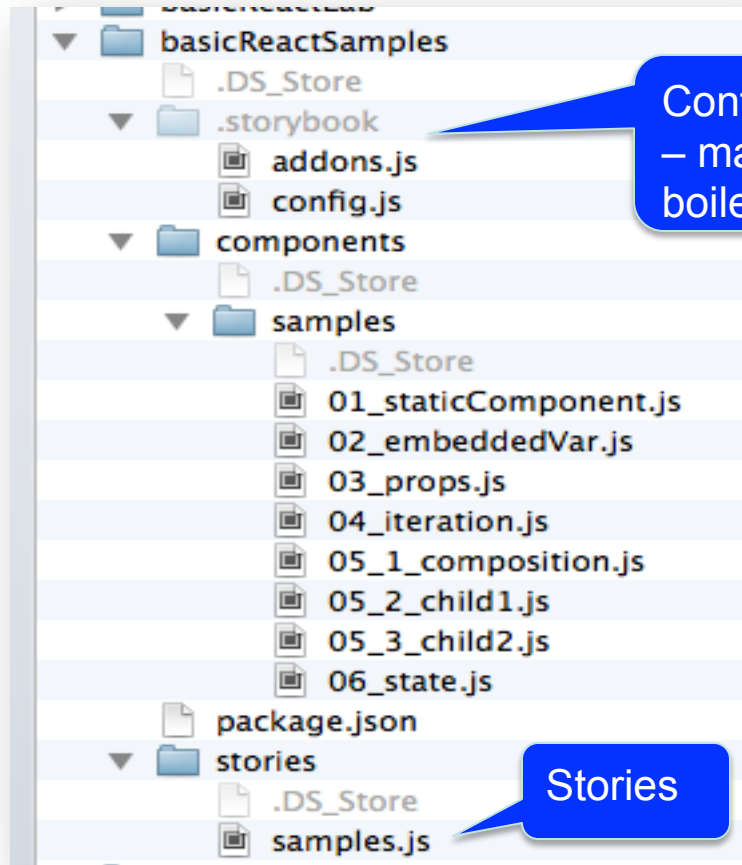
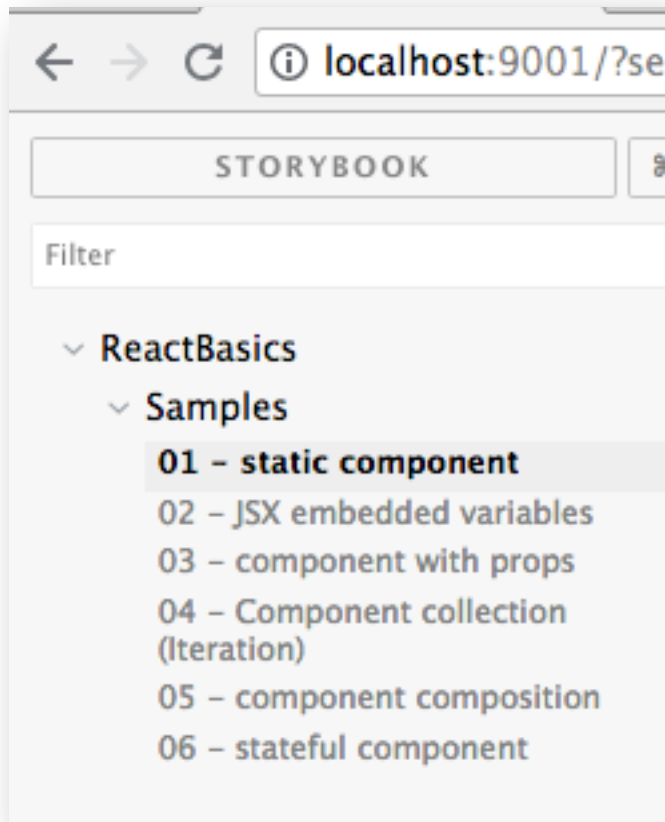
A Story



... back to components . . .

# Samples

- Samples to demonstrate Component features.
  - Basis for this week's lab..



# JSX embedded variables.

- Dereference variable embedded in JSX code using { } braces.
  - Braces can contain any valid JS expression.
- Reference 02\_embeddedVariables.js

JS 02\_embeddedVar.js ×

```
1  import React , { Component } from 'react';
2  export default class DynamicLanguagesEmbeddedVars extends Component {
3      render() {
4          let languages = ['Go', 'Julia', 'Swift']
5          let header = 'Modern'
6          return (
7              <div className='myCSSstyle' >
8                  <h1>`${header} Languages`</h1>
9                  <ul>
10                     <li>{languages[0]}</li>
11                     <li>{languages[1]} </li>
12                     <li>{languages[2]} </li>
13                 </ul>
14             </div>
15         );
16     }
17 }
```

# Reusability.

- **Achieve reusability through parameterization.**
- **props – Component properties/attribute;**
  - **Passing props to a component:**  
`<CompName prop1Name={value} prop2Name={value} . . . . />`
  - **Access inside component via this.props object:**  
`let p1 = this.props.prop1Name`
  - **Immutable.**
- **Reference 03\_props.js and related story.**

## Aside – Some JS issues

- When an arrow function has only ONE statement, which is its return value then you may omit:
  - Body curly braces; 'return' keyword; Semi-colon
- The Array map method - creates a new array with the results of calling a provided function on every element in the calling array.

```
1  let frameworks = [  
2    {name: 'React', url : 'https://facebook.github.io/react/'},  
3    {name: 'Vue', url : 'https://vuejs.org/'},  
4    {name: 'Angular', url : 'https://angularjs.org/'}  
5  ] ;  
6  const names = frameworks.map((f,index) => `${index+1}. ${f.name}` )  
7  console.log(names)  
8  // [ '1. React', '2. Vue', '3. Angular' ]  
9
```

```
React.createElement( 'h1', null, 'something' ),  
React.createElement( "h2", null, "Sub something")  
);
```

# Aside – Some JS issues

- Background (contd.):
  - We can assign a single **JSX** element to a variable.

```
9  
0  - const demo = <div>  
1      <h1>Something</h1>  
2      <h2>Something else</h2>  
3      </div> ;
```

# Component collection - Iteration

- **Obj.:** Generate a collection of component instances.
- **Reference** 04\_iteration.js

```
▼ <div>
  <h1>JS client-side Web</h1>
  ▼ <ul> = $0
    ▼ <li>
      <a href="https://facebook.github.io/react/">React</a>
    </li>
    ▼ <li>
      <a href="https://vuejs.org/">Vue</a>
    </li>
    ▼ <li>
      <a href="https://angularjs.org/">Angular</a>
    </li>
  </ul>
</div>
```

Real DOM  
produced by story  
(From Chrome  
Dve Tools)

# The render() return value.

- **Examples:**

- return <h1>Something</h1> ;
- return <Frameworks frams={frameworks} type={type} /> ;
- return (  
    <div>  
        <h1>{this.props.type}</h1>  
        <ul>  
            . . . . .  
        </ul>  
    </div>  
);

- **Must enclose in ( ) when multiline.**



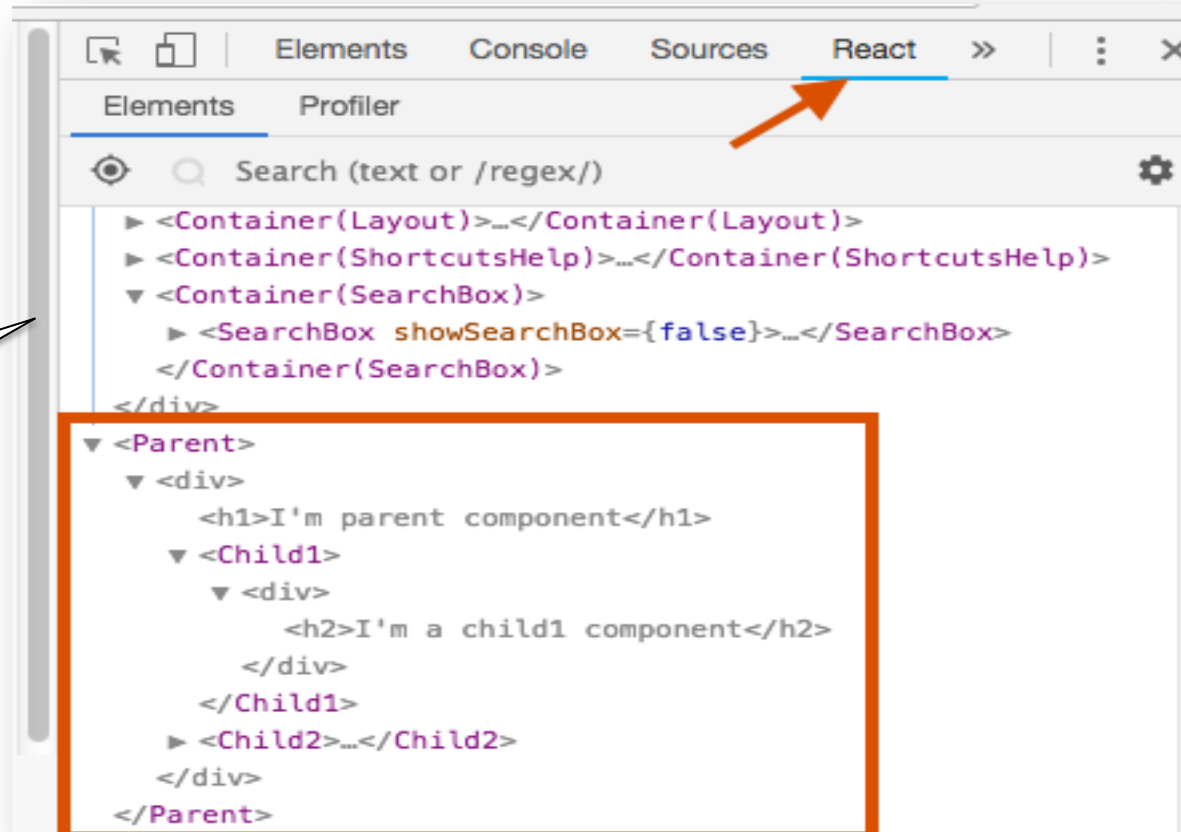
# The render() return value.

- **Must return only ONE element.**
- **Examples:**
  - return (  
    <h1>{this.props.type}</h1>  
    <ul>  
        .....  
    </ul>  
);
  - **Error** – ‘Adjacent JSX elements must be wrapped in an enclosing tag’
  - **Solution: Wrap in a div tag.**

# Component *Composition*.

*A React application is designed as a hierarchy of components.*

- **Components have children – nesting.**
- **See *05\_1\_composition.js*.**



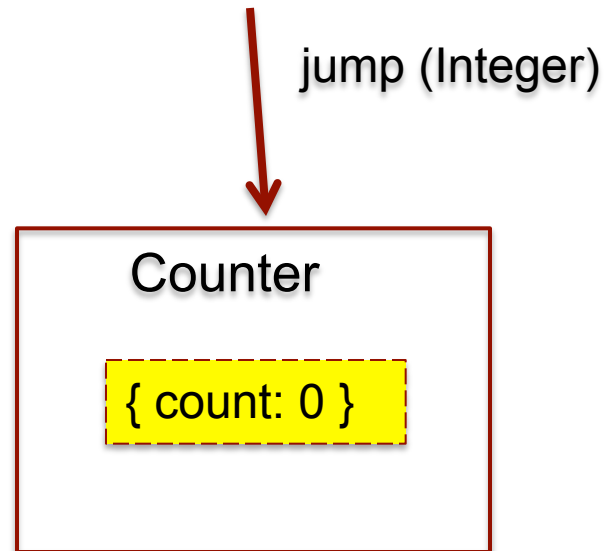
From Chrome  
Dev Tools React  
extension

# Component DATA

- **Two sources of data for a component:**
  - Props - **Immutable; Passed in by parent component.**
  - State – **Dynamic; Managed internally by the component**
- **State-related component features:**
  1. **Initialize state values.**
  2. **Change the state values- the setState() method.**
    - **Change some or all state values (merge, not overwrite).**
    - **Automatically causes component to re-render. \*\*\***
- **Props-related component features:**
  1. **Set default prop values.**
  2. **Type-checking.**

# Making components interactive and dynamic

- **Ex:The Counter component.**
- **Ref. 06\_state.js**
- **Component class coding features:**
  1. **Custom functions,**  
e.g. incrementCount().
  2. **Static class property,**  
e.g. defaultProps.
  3. **Class instance property,** e.g. state.



# React's event system.

- **Cross-browser support.**
- **Event handlers receive SyntheticEvent – a cross-browser wrapper for the browser's native event.**
  - Same interface as native event
- **Event naming convention slightly different from native:**

React	Native
onClick	onclick
onChange	onchange
onSubmit	onsubmit

- See <https://reactjs.org/docs/events.html> for full details,

# Re-rendering

- **EX.: The Counter component.**

*User clicks 'increment' button*

*→ onClick event handler (incrementCounter) executed*

*→ state is changed (setState())*

*→ render() method executed*

# The Virtual DOM

- **Traditional performance best practice:**
  1. **Avoid expensive DOM operations.**
  2. **Minimize access to the DOM.**
  3. **Update elements offline before reinserting into the DOM.**
  4. **Avoid tweaking layouts in Javascript.**
- **Should the developer be responsible for low-level DOM optimization? Probably not.**
  - **React solution is the Virtual DOM.**
  - **A challenge to established thinking!**

# The Virtual DOM

- **Re-render everything on every update.**
  - **Sounds expensive!**
- **How?**
  1. **Create lightweight description of app's UI (The Virtual DOM)**
  2. **Perform *diff* operation between it and the previous (virtual) UI state.**
  3. **Compute the minimal set of changes to apply to (real) DOM.**
  4. **Batch execute all updates to real DOM.**
- **Benefits:**
  - a) **Clean – Clean, descriptive programming model**
  - b) **Fast - Optimized DOM updates and reflows.**



# Re-rendering (detail)

- **EX.: The Counter component.**

*User clicks 'increment' button*

*→ onClick event handler (incrementCounter) executed*

*→ state is changed (setState())*

*→ render() method executed*

*→ The **Virtual DOM** has changed*

*→ React diffs the changes (between the current and previous Virtual DOM)*

*→ React batch updates the **Real DOM***

